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Faculty of Unani Medicine, Aligarh Muslim University, Aligarh, India - 202002

Phone No. +91-571-2400302 (Off.), +91-9368003661

E-mail: jichindia@gmail.com

# Thermoregulation: An Important Function of *Tabia't*

Md Imran Khan<sup>1</sup>, Sana Sultana<sup>1</sup>, Sayid Ahmad<sup>1</sup>, F. S. Sherani<sup>2</sup>, Ferasat Ali<sup>3</sup>

<sup>1</sup>PG Scholars, Department of Kulliyat, Faculty of Unani Medicine, Aligarh Muslim University, Aligarh, India

<sup>2</sup>Professor, Department of Kulliyat, Faculty of Unani Medicine, Aligarh Muslim University, Aligarh, India

<sup>3</sup>Associate Professor, Department of Kulliyat, Faculty of Unani Medicine, Aligarh Muslim University, Aligarh, India

E-mail: [dr123imran@gmail.com](mailto:dr123imran@gmail.com)

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## Abstract

*Unani System of Medicine provides a holistic approach towards health and disease. The concept of tabiat is one of most fundamental concept of unani medicine. This concept was given by the father of medicine, Hippocrates. Hippocratic doctrines describe tabiat as the administrator of human body and healer of the disease. Every natural and physiological action of human body is controlled and administered by tabiat. It is an inherent wisdom of human body gifted by Almighty Allah, to maintain each and every function of human body within physiological limit. This administrative force is termed as physis or nature by Greeks. Arab physicians expressed it as tabia't mudabbara badan. Thermoregulation is one of the most fundamental physiological regulations in our body. The body temperature is regulated by hypothalamus which sets the normal range of body temperature. Hypothalamus has two centres which regulate the body temperature; heat loss centre, heat gain centre. The governing power behind thermoregulatory action of hypothalamus is tabia't mudabbara badan.*

**Key Words:** Physis, *Tabia't mudabbara badan*, Thermoregulation, Hypothalamus

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## Introduction

Unani medicine provides holistic approach for maintenance of health and prevention from disease. From various fundamental concepts given by the father of medicine, Hippocrates, the concept of *tabiat* is one of them. Hippocratic doctrine describes *tabiat* as the administrator of human body,

which controls each and every physiological function of human body with in limit. This power not only maintains condition of health but also it acts as healer of the disease. In condition of disease it fights with the causative agent until unless removes it or became powerless against it. So the unani system of medicine put great emphasis to help the *tabiat* and physicians are

advised to maintain the power of *tabiat* through their prescriptions. *Tabiat* is regarded as supreme power of human body, which adjusts the function of the body to the demands of different circumstances.

Thermoregulation is one of the most fundamental physiological regulations in our body. The body temperature is regulated by hypothalamus which sets the normal range of body temperature. The governing power behind thermoregulatory action of hypothalamus is *tabia't mudabbara badan*. Within our body, there is an arrangement, by which our body temperature remains at around 37°C, irrespective of external temperature. If there is cold environment in the outside, there is cutaneous vasoconstriction, standing up of hair and shivering, or, when there is a hot environment, there is sweating, cutaneous vasodilation and relaxation of the muscle tone. By these mechanisms, the body heat is either preserved or vigorously loss to the exterior and the temperature within the body remains constant at 37°C. *Tabia't* detects the external environmental temperature and when necessary sets the thermoregulatory mechanism in our body in action through hypothalamus.

### Concept of *Tabia't* in *Unani System of Medicine*

Hippocrates said that the *physis* is the healer of disease. By *physis* he meant those powers that carry on the administration of the body. When the *physis* is powerful enough to withstand the disease it does not require the aid of the physician, but only for the purpose to overcome the disease as soon as possible. In condition of equality of powers of *physis* and disease, the aid of physician became necessary. When *physis* is weaker than disease, the aid of physician is very necessary.<sup>1</sup> The word *physis* occurs in two senses (a) the power which administers the body involuntarily and (b) the power which performs actions suitable to the body and When a disease is chronic then in most cases *physis* removes it little by little or is perplexed and becomes powerless against it.<sup>2</sup>

*Tabia't* or *physis* is proximate or direct cause of movement and rest. It is the supreme administrative power of bodies.<sup>3,4,5</sup>

It means all natural and living things are either in process of formation or destruction. The cycle of formation and destruction is going on, as one thing is formed and another one is destructed and vice versa. Formation occurs due to movement and transformation. So *Tabia't* initiates the movement for the formation of the things. Destruction occurs when the formative movement diverted towards rest or destruction. Between formation and destruction rest is compulsory. Galen said it as *quwat-e mudabbirah badan* of all natural and living things.<sup>4</sup>

According to *Tibb* the cause of health is the maintenance of *mu'atadil-mijaz* within the cells, tissues, organs and the entire body. Maintenance of *mu'atadil mijaz* means the maintenance of static or constant conditions (homeostasis) in the internal environment of the cells or the whole body. The power maintains this *e'tadal-al-mizaj* is known as *tabia't mudabbara badan*, which is considered as supreme power of our body and hose sole function is to maintain *e'tadal-al-mizaj* (homeostasis) in the body. The concept of *tabi'at* is a basic one in the *tibb*. It is a supreme power, a controller of homeostatic mechanism, which maintains the *e'itadal al-mijaz*, the basis of our health.

Thus from the above account it is evident that *tabia't* functions in two ways:

1. In physiological conditions it maintains the *mu'atadil mijaz* (homeostasis) in the internal environment of the body for the proper functioning of the cells, tissues and organs.
2. In case the body becomes diseased i.e. *su'al mijaz* takes place, *tabiat* fights against the disease and in appropriate conditions the *e'tadal al-mijaz* (homeostasis) is regained and ultimately the patient is cured.<sup>6</sup>

Each and every physiological function of human body is controlled by *tabiat* and

performed in guidance and with the permission of it.

## The Thermoregulation

Thermoregulation is the ability of an organism to keep its body temperature within certain boundaries, even when the surrounding temperature is very different. This process is one aspect of homeostasis.<sup>7</sup>

Thermoregulation is one of the most fundamental physiological regulations in our body. Man (and other mammals as well as birds) are homoeothermic, that is, whatever may be the environmental temperature, and their own body temperature does not vary. The ability to keep the body temperature within a very narrow range, the temperature homeostasis, is possible because of the operation of thermoregulatory mechanism which is present in the mammals.<sup>8</sup>

### Normal body temperatures

Normal production of heat, when the temperament of all organs is in balance, is beneficial for body functions. It is called *hararat-e-gharizia*.<sup>5</sup>

The temperature of the deep tissue of the body- the core of the body -remains almost exactly constant, within  $\pm 1^{\circ}\text{F}$  ( $\pm 0.6^{\circ}\text{C}$ ), day in and day out except a person develops a febrile illness. Indeed, a nude person can be exposed to the temperatures as low as  $55^{\circ}\text{F}$  or as high as  $130^{\circ}\text{F}$  in dry air and still maintains an almost constant core temperature. The skin temperature, in contrast to the core temperature, rises and falls with the temperature of the surroundings.<sup>9</sup>

Oral temperature of normal healthy adults, at rest, at 8a.m. is around  $37^{\circ}\text{C}$ . Range of oral temperature in healthy adults, at rest, is between  $35.8^{\circ}\text{C}$  to  $37.8^{\circ}\text{C}$ . Rectal temperature is usually some  $0.5^{\circ}\text{C}$  more than that of oral temperature. After a severe bout of exercise the body temperature of a normal adult may be as high as  $40^{\circ}\text{C}$ . In the children temperature regulation is not being highly satisfactory; temperature may occasionally be high (in summer) or low (in winter). Non pregnant women in their reproductive phase of life, show usually  $0.5^{\circ}\text{C}$  higher body temperature in their luteal phase of menstrual cycle.<sup>8</sup>

## Importance of Thermoregulation

When thermoregulation is disturbed due to any cause and temperature of organ decreases or increases from normal, then accordingly the body functions are affected.<sup>5</sup>

If the temperature rises too much, the proteins of our body begin to deteriorate, resulting in deterioration of enzymatic functions (all enzymes are protein in nature), and thus causing a havoc. Further elevation of temperature causes beginning of denaturation of protein. Cold, on the other hand, inhibits the enzymatic activity of our body; contractility of heart muscles also suffers. Therefore, to remain alive, internal temperature must be within a narrow range.<sup>8</sup>

### Heat production

From the various complicated functions of *physis*, which takes place in the body during day and night, one of the functions is production of heat.<sup>5</sup> Heat production is principle by-product of metabolism. The most important of these factors are listed here:

- 1) Basal rate of metabolism of all the cells of the body;
- 2) Extra rate of metabolism caused by muscle activity, including muscle activity caused by shivering;
- 3) Extra rate of metabolism caused by effect of thyroxin on the cells (and also other hormones, such as growth hormone and testosterone);
- 4) Extra metabolism caused by epinephrine, nor epinephrine and sympathetic stimulation on the cells;
- 5) Extra metabolism caused by increased chemical activity in the cells themselves, especially when the cell temperature increases.<sup>9</sup>
- 6) Extra metabolism needed for digestion, absorption and storage of food (thermogenic effect of food).<sup>13</sup>

### Causes of heat (calorifics)

Agents of heat are of different kinds, such as; Moderate quantity of food; Moderate movement, which include moderate exercises;

Moderate massage; Moderate pummelling; Dry cupping because wet cupping causes depletion of blood and produces cold; Movement which is more than moderate but not too severe and excessive; Hot food; Hot drugs; Moderate heated bath as it is known that it produces heat by its air and water; Occupations involving the use of fire; Contact of the body with things which produce heat but are not excessively hot as air and plasters; Moderate wakefulness; Moderate sleep, provided it is according to the aforementioned condition; Anger in all conditions; Worry when it is not excessive produces cold; Moderate happiness & also Putrefaction which has the property of producing nothing but foreign heat.

As is the practice of Galen he classified all these agents of heat into five groups: movement which is not excessive; contact with a thing which produces heat but not in excess; hot food or drink; denseness; putrefaction.<sup>10</sup>

*Rabban Tabri* described eight causes which increase the body temperature. (1) Tiredness and strenuous work (2) prolonged stay in hot air and sun light (3) putrefaction (4) obstruction in body vessels (5) eating foods and drugs of hot temperament (6) extreme hunger and thirst (7) sorrow and (8) anger.<sup>3</sup>

#### Heat loss:

Most of the produced in the body is generated in the deep organs, especially in the liver brain and heart, and the skeletal muscle during exercise. Then this heat is transferred from deeper organs and tissues to the skin, where it is lost to the air and other surroundings. Therefore, the rate at which the heat is lost is determined almost entirely by two factors: (1) how rapidly heat can be conducted from where it is produced in the body core to the skin and (2) how rapidly heat can then be transferred from skin to the surroundings.<sup>9</sup>

These are the channels of heat loss; conduction, convection, radiation, evaporation of sweat, loss through urine and faeces, respiration.<sup>8</sup>

#### Causes of cold (refrigerants)

Cooling agents are also of different kinds: Excessive rest which confines the innate heat; Excessive eating and drinking; Excessive reduction in food and drinks; Cold ailment; Cold drugs; Contact of the body with things producing heat in excess such as scorching winds, hot plasters and water of hot springs. Excessive flabbiness of the body which causes dispersion of innate heat; Prolonged contact with things which produces moderate heat for example prolonged stay in baths; Excessively narrow pores which smother the innate heat. Contact with things which actually produce cold; Contact with things which potentially produce cold though they may be presently hot. Excessive retention because (of superfluous matter) which smother the innate heat. Excessive depletion which causes the loss of matter containing tight and prolonged bandaging of an organ which blocks the passage of innate heat; Excessive worry; Excessive fear. Excessive joy and pleasure; Occupations producing coldness; Immaturity or rawness which is the opposite of putrefaction.

As is the practice of Galen he classified them into six groups: Excessive movement. Excessive rest; Contact with things which produce so much heat that it causes dispersion. Matter having cooling effects; Excessive reduction of food; Excess of food.<sup>10</sup>

According to *Rabban Tabri*, inverse causes of heat producing cause increases body temperature: (1) Excessive rest (2) excessive expense of heat due to heavy work (3) use of cold temperament medicine (3) excessive drinking and eating (4) prolonged stay in cold air (5) body weakness (6) fullness of excretory material in the body.<sup>3</sup>

#### Regulation of body temperature

Since the production of heat is a continuous process in the body likewise loss of heat is also continuous. And maintenance of regulation of heat is done by *physis*. So when the body temperature increases due to any cause like running, exercise, exposure to sun light, the *physis* increases the expense of heat through dilatation of skin vessels, increased sweating and

consequent evaporation and frequent inspiration of cold air.

Inversely when the body temperature decreases, then *physis* takes different actions to fulfil this loss like increase the desire of hot foods; increase the digestion of food, desire to take sun light and covering of body etc. So that the thermoregulation is in control of *physis*.<sup>5</sup>

The body temperature is regulated by hypothalamus which sets the normal range of body temperature. Hypothalamus has two centres which regulate the body temp.

1. Heat loss centre
2. Heat gain centre<sup>11</sup>

#### Adaptation to heat:

Immediate response of the human body to exposure to inconveniently high heat is by sweating whereby the evaporation of the moisture exuding through the pores of the skin takes away its latent heat and cools it. Attendant with it is greater blood flow closer to the skin surface and hyperventilation. Basic metabolic rate is also lowered to produce the less heat in the body and the resting body temperature sinks.<sup>12</sup>

These all changes in the human body in response to high heat have done through heat loss centre. This centre is situated in preoptic nucleus of anterior hypothalamus. The neurons of this nucleus are sensitive to heat. When body temperature increases, the warm blood stimulates the heat sensitive neurons.<sup>11</sup>

#### Temperature decreasing mechanism when the body is too hot:

When the temperature of body increases from normal it is called *hararat-e-gharibiah*.<sup>5</sup>

Three important mechanisms:

- 1) Vasodilation: this is caused by inhibition of sympathetic centre in the posterior hypothalamus that cause vasoconstriction. Full vasodilation can increase the rate of heat transfer to the skin as much as eightfold.

- 2) Sweating: an additional 1°C increase in body temperature causes enough sweating to remove the 10 times the basal rate of heat production.
- 3) Decrease in heat production: the mechanism that causes excess heat production, such as shivering and chemical thermogenesis are strongly inhibited.<sup>9</sup>

#### Adaptation to cold:

Whenever the environmental temperature happens to be too low the human body reacts to it by shivering, production of goose skin and vasoconstriction. The metabolic accelerators hormones act to produce more heat. Thus loss of heat is diminished and production of heat increased as a response to cold.<sup>12</sup>

These all changes in the human body in response to high heat have done through heat gain centre. It is otherwise known as heat production centre. It is situated in posterior hypothalamic nucleus. This part of hypothalamus has neurons, which are sensitive to cold. When body temperature decreases the heat gain centre plays an important role in maintaining the temperature.<sup>11</sup>

#### Temperature increasing mechanism when the body is too cold:

When the body temperature decreases from normal it is called *harart-e-muqassarah*.<sup>5</sup>

Body raises the temperature through taking following actions.

- 1) Skin vasoconstriction throughout the body: this is caused by stimulation of posterior hypothalamic sympathetic centres.
- 2) Piloerection: sympathetic stimulation cause the erector pili muscles attached to the hair follicles to contract which brings the hair in upright stance. Upright projections of the hair allow them to entrap a thick layer of insulating air next to skin, so that transfer of heat to surroundings is greatly depressed.

- 3) Increase in heat production: heat production by the metabolic system is increased by promoting shivering, sympathetic excitation of heat production and thyroxine secretion.<sup>9</sup>

## Effects of exposure to cold and heat

### Effect of exposure to severe cold:

The effects of exposure of body to extreme cold are:

- 1) Loss of temperature regulating capacity: the capacity of hypothalamus in regulating the body temperature is affected when the body temperature reduces to 34.4°C. The hypothalamus totally loses power of temperature regulation when body temperature falls below 25°C. Shivering does not occur.
- 2) Frostbite: when body is exposed to low temperature the surface of the body is frozen. The freezing is known as frostbite. It occurs due to sluggishness of blood flow. Most commonly affected parts are the ear lobes and digits of the hands and feet. Frostbite is common in mountaineers.<sup>10</sup>

### Effect of exposure to heat:

- 1) Heat exhaustion: when the body is suddenly exposed to increased environmental temperature, heat exhaustion occurs. It results in loss of consciousness and collapse.
- 2) Dehydration exhaustion: prolonged exposure to heat results in dehydration. It is due to excessive sweating. Dehydration leads to fall in cardiac output and blood pressure. Collapse occurs if treatment is not given immediately.
- 3) Heat cramps: Severe painful cramps occur due to reduction in the quantity of salts and water as a result of increased sweating during the continuous exposure to heat.
- 4) Heatstroke: heat stroke is a severe and often a fatal illness, which occurs when

body is exposed to extreme heat and when the body temperature rises above 41°C. The hypothalamus loses the power of regulating body temperature.<sup>11</sup>

## Conclusion

Hippocrates gives the concept of *tabiat* and used the term *physis* for it. The Greek word was translated by Arab physicians as *tabiat* and sometime as *tabiat mudabbira badan*. This holistic conception that is meant by Arab physicians cannot be fully expressed by any modern scientific terms such as immunity or natural defence mechanism, which can note only some specific aspect of *tabiat mudabbira badan*. It is administrator of human body not only in health but also in condition of disease (as the quality should be present in an administrator). Human body possesses hypothalamus which is one of the important administrative organ. Hypothalamus takes every necessary action to cope with adverse situation and to maintain the normal physiological functions of human body. From various functions, thermoregulation is one of the most important function of hypothalamus. Maintenance of optimum temperature is necessary for proper functioning of body. Under the guidance of *tabiat*, hypothalamus regulates the body temperature very well. With maintenance of optimum temperature, not only enzymatic function but also all other physiological functions of the human body became well regulated.

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